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Office of Space Flight
Standard Spaceborne Global Positioning System User Equipment Project

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The Global Positioning System (GPS) provides users autonomous, real-time navigation capability. A vehicle equipped with GPS user equipment can receive and process signals transmitted by a constellation of GPS satellites and derive from the resulting measurements the vehicle's position and velocity. Specified accuracies range from 16 to 76 meters and 0.1 to 1.0 meters/second for position and velocity, respectively. In a rendezvous and docking scenario, the use of a technique called relative GPS can provide range and range rate accuracies on the order of 1 meter and 0.01 meters/second, respectively. Relative GPS requires both vehicles to be equipped with GPS user equipment and a data communication link for transmission of GPS data and GPS satellite selection coordination information. Through coordinated satellite selection, GPS measurement errors common to both users are cancelled and improved relative position and velocity accuracies are achieved.

NASA has spent many years pursuing the incorporation of GPS into its space vehicles. The Space Shuttle is scarred for two strings of GPS user equipment. The Space Station has baselined GPS to provide Space Station position and velocity, time reference data, and relative tracking of cooperative, unmanned vehicles within the Station's command and control zone. Consideration is being given to the use of GPS in the Assured Crew Return Vehicle and in the various launch and orbital transfer vehicles. Johnson Space Center (JSC) has worked with NASA Headquarters and several field centers to develop the concept of a standard GPS user equipment set designed to be used in multiple space vehicle programs. The decision was made by the Associate Administrator for the Office of Space Flight (Code M) to pursue a standard GPS development for use in Code M space vehicles.

The standard GPS design approach is to use off-the-shelf GPS user equipment and modify the design to provide a modular architecture, the required NASA vehicle interfaces, and the capability for growth to include future user requirements. Over half a dozen GPS user equipment manufacturers responded to a request for information regarding the approach manufacturers would take in the development of standard spaceborne GPS user equipment. All vendors responded with proposals to modify an existing design.

The standard GPS project definition phase is planned for FY92-93 with the development phase beginning in FY94 and the production phase beginning in FY96. The project is managed by the Advanced Development Office (Code MD) with JSC designated as the lead center for managing the technical aspects of the project. The project is funded for FY92-93. Funding for the development and production phase is uncertain. Definition phase activities include the preparation of a request for proposal with the associated procurement specification, the performance of required trade studies, and the testing of candidate GPS user equipment sets.

This presentation describes the background, the design approach, the expected performance and capabilities, the development plan, and the project status. In addition, a description of relative GPS, the possible GPS hardware and software configurations, and its application to automated rendezvous and capture is presented.